Concordia
UNIVERSITY

ARTS AND SCIENCE

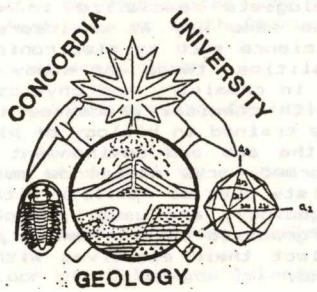
GEOLOGY

P. POISSON, JEN. GODDARD FECERUNT

1990-91

CONCORDIA UNIVERSITY

DEPARTMENT OF GEOLOGY



COURSE GUIDE

1990-91

This course guide has been prepared months in advance of the current academic year and information contained is subject to change. Also note that the class location, day and time in which courses are offered may be found in the official "Class Location - Undergraduate Courses" booklet purposely published at the beginning of each new academic year.

For more detailed information contact:

Department of Geology
Loyola Campus
7141 Sherbrooke St. West
Montreal, Quebec
H4B 1R6

Tel: (514) 848-3300

WHAT IS GEOLOGY

Geology is the scientific study of the planet Earth. The basic principles of geology learned on Earth, have also been vital in the effort to understand the Solar System.

Study of rocks, minerals and fossils..., processes that shape the Earth's surface and operate in its interior..., the magnetic and other radiation fields of Earth..., landslides, earthquakes and their prediction..., soil formation, erosion and conservation..., effect of man's activities on the Earth's environment..., metal, fuel and water resources, their search, use and conservation..., sites for roads, dams and buildings..., ocean floors and mountain chains..., surface features of the Moon and other planets..., all this and more is geology.

The scope of geology is too broad for any one scientist, therefore, most geologists specialize in one or more facets of geology, in much the same way as engineers specialize in various fields of physical science such as electronics and construction. To mention a few specialities: those who study minerals and rocks need specialized training in chemistry and physics, as do the geochemists who are concerned with chemical processes in the Earth; those who study fossils must be trained in biology of plants and animals so that they can interpret the age and environment of ancient life forms; those who study deformed rocks must know mechanics, and groundwater and petroleum geologists must be familiar with fluid dynamics. These specializations in geology, are usually emphasized at the graduate level. At the undergraduate level, however, students can, with the help of faculty, select their electives with a particular field of specialization in mind.

GEOLOGY TODAY

Geology has started off the 1980s with a bang, both literally and figuratively. Explosive eruptions from Mt. St. Helens and from other volcanoes, severe earthquakes; droughts, floods and disastrous slope failures; exciting discoveries from direct observations of the deep-sea floor and from images of the outer planets of the solar system are big news. At the same time, the end of the era of abundant and cheap energy from fossil fuels and the widespread realization that man's meddling with Nature is beginning to produce long-term and perhaps irreversible deterioration of the environment has forced on every citizen the importance of knowing how the Earth works. Furthermore, the search for ever more elusive mineral and hydrocarbon deposits, the estimation of potential resources, the devising of sound environmental practices, all require progressively more sophisticated practice of geology. So, too, does a continuing assessment of the ability of the Earth's environment to sustain our edifices and to contain our wastes. The knowledge of geologists is needed more urgently and in more ways than ever before.

Geology, as a science, has undergone a major transition during the last three decades and continues to evolve rapidly. What was largely an observational and descriptive discipline has, in addition, changed into a largely quantitative, experimental and predictive science. During this period of change advanced concepts of physics, chemistry and mathematics have been applied to solve geological problems which have previously resisted solution. The scientific study of the Earth has thus taken on a broader scope, embodying sub-disciplines such as geophysics and geochemistry and is now referred to as Earth Sciences or Geosciences.

WHAT GEOLOGISTS DO

In pursuing a discipline that is so varied and so large in scope, geologists engage in many kinds of activities. Field work may be a major part of their study in which results have to be compiled in the

office and reports written about the results. This kind of work is centered around libraries. Much geological work is also done in the laboratory using various sophisticated equipment. Some geologists study natural processes, both in the field and in the laboratory. The main work of one group of geologists consists entirely of theorizing. The following are samples of some of the things geologists do:

- mapping on a regional scale the still unmapped parts of the Canadian Artic Islands
- study, in a laboratory, properties of rocks and minerals at high pressure and high temperature
- SCUBA diving to study coral reefs off Barbados
- surveying on mule-back or helicopter the mineral potential of mountainous areas in Australia or South America
- exploring for water in an arid region
- working as a member of a UN mission to field study an earthquake striken area in Turkey
- interpreting by means of satellite images the geology of vast, inaccessible regions
- deciding if and where subsurface mining should be extended
- studying the ocean floor off Galapagos Islands
- investigating the effects of acid rain in southern Ontario
- investigating the origin of the Earth's magnetic field
- teaching in school or teaching and research at university
- advising a government on its mineral and energy policies
- working in a co-operation with engineering groups in the design of major-hydroelectric construction projects

EMPLOYMENT OPPORTUNITIES

Prior to the current period, employment opportunities for new graduates in geology were excellent. Forecasters on future outlook are optimistic that opportunities for employment will be sustained at a high level well beyond the year 2000. The employment situation is far from buoyant at the present time but is still better than in other areas of natural sciences. The principal employers are: federal and provincial geological surveys, government research institutes, companies engaged in oil and mineral exploration and engineering works, the United Nations and U.N. sponsored agencies, universities and schools. Some geologists practice their profession as consultants.

OBJECTIVES OF THE GEOLOGY DEPARTMENT

The continuing objective of the Geology Department is to offer the best undergraduate education in geology; best in the quality of the programmes, in the quality of teaching and facilities and in the quality of interaction between students and faculty members.

FULL-TIME FACULTY AND THEIR FIELDS OF INTEREST (in 1989-90)

H.S. de Romer, PhD (McGill), Associate Professor
Structural Geology, Photogeology

J.T. Jenkins, MSc (McGill), Associate Professor
Crystal Chemistry, Mineralogy, Igneous and Metamorphic Petrology

P.S. Kumarapeli, PhD (McGill), Associate Professor
Tectonics, Geophysics

D.J. McDougall, PhD (McGill), Professor
Mineral Physics, Thermoluminescence, History of Mining and Geology

K.K. Mukherji, PhD (Univ. of Western Ontario), Associate Professor and Chairman
Carbonate Petrology, Sedimentation

G.P. Sassano, PhD (Univ. of Alberta), Associate Professor
Economic Geology and Mineral Deposits

PART-TIME FACULTY (in 1989-90)

Dr. J. Béland, PhD, Princeton, New Jersey

Dr. J. Bishay, PhD, Alexandria University, Egypt

Dr. D. Desaulniers, PhD, University of Waterloo, Ontario

Mr. S. Perreault, MSc, McGill University

Mr. E.L. Procyshyn, BSc, Queen's University, Kingston, Ontario

Dr. K. St. Seymour, PhD, Visiting Research Scholar

STAFF (in 1989-90)

L. Bertrand - Secretary

M. Kwiatkowski - Technician

M. Paventi - Technician

FACULTY RESEARCH

The faculty members have carried out geological work in various parts of Canada, U.S.A., the Alps, the Near East, Middle East, India, Sri Lanka and in South America. Current research activities are concentrated in the Quebec Appalachians, Spain, Italy and the Canadian Shield.

FACILITIES

In addition to general facilities and services such as the libraries and the computer centre provided by the university, the Department maintains well-equipped laboratories with adequate study collections of minerals and rocks including thin and polished sections for microscopic studies, fossils, maps and air photos. The Department also has its own X-ray diffraction equipment, geophysical equipment, fluid inclusion thermometry equipment, and facilities for the preparation of material for laboratory study. Access to other analytical facilities as Atomic Absorption and X-ray fluorescene equipment is available from other departments. Two 15-seater vehicles are available for field trips.

STUDENT PARTICIPATION

The Concordia Geology Club, run exclusively by students has reasons to be proud of its record. Activities include sponsoring guest lecturers, organizing field trips, preparing and manning exhibits at the annual Science week at Concordia University and at the Prospectors and Developer's Convention in Toronto, inviting through its job committee, prospective employers to the campus to interview students for summer as well as permanent employment and organizing several social events including the Spring party. Upper year students with above average academic records are provided the opportunity of getting teaching experience through demonstration in laboratory classes. A stipend is paid for this work.

SCHOLARSHIPS, FINANCIAL AID, AWARDS, MEDALS AND PRIZES

Scholarships and prizes are given in recognition of outstanding academic achievements. The Andre Deland Medal for Geology is awarded annually, when merited, to the graduating student with the highest standing in geology. Two annual awards are given by the Canadian Society of Petroleum Geologists to undergraduates who have demonstrated outstanding competence in fields related to petroleum geology. The Mineralogical Association of Canada also gives an annual award. Financial aid is given to help students solve individual problems. For information on bursaries students are advised to refer to the Office of the Dean of Students.

SUMMER EMPLOYMENT

Students are urged to make every effort to obtain summer employment with geological field parties. In addition to obvious financial benefits, these jobs provide valuable field experience. Student Job Committee as well as the Department invite prospective employers to the Campus but the task of job procurement is the responsibility of students. Federal and Provincial geological surveys and companies involved in mineral and oil exploration are the principal employers. Summer employment opportunities for students usually follow economic trends.

PRE-UNIVERSITY EDUCATION FOR GEOLOGISTS

Students contemplating a career in Geology should acquire a strong background and interest in the basic sciences and mathematics in their pre-university education. They will also need an enquiring and open mind, an ability to grasp fundamental scientific principles quickly and easily and to communicate ideas clearly. They must be able to apply the basic principles of chemistry, physics, biology and mathematics and to use deductive reasoning to solve complex geological problems.

GEOLOGY PROGRAMMES

The Department offers a total of eight programmes. Four are in Geology at different levels of concentration: Honours, Specialization, Major and Minor. Out of the 90 credits necessary for a B.Sc. and normally taken over a 3-year period, the programmes specify 69 credits for Honours; 63 credits for the Specialization, 39 credits for the Major and 24 credits for the Minor. The remaining four programmes are geology-based interdisciplinary programmes aimed at preparing students who wish to follow careers in some of the sub-disciplines of Earth Sciences. These are at the Specialization level: one with Physics (83 credits) to prepare students who wish to follow careers in geophysics through subsequent job training or graduate studies, a second with chemistry (82-83 credits) to provide

background preparation for students who wish to pursue careers in geo-chemistry, a third with geography aimed at students who wish to pursue careers in the evaluation and management of earth resources (78 credits) and a fourth combines geology with ecology (78 credits).

Students with professional aspirations should register in the Specialization programmes. These programmes are designed for professional development and provide balanced sequences of courses in both theoretical and practical aspects. Students entering the Specialization in Geology can later change into the Honours programme in Geology, provided their grades are sufficiently high. The Honours programme provides the best all around preparation for those who wish to pursue graduate studies and research in geology.

The Major programme is aimed at the generalist. It does not provide sufficient preparation for students to function as professional geologists.

Lectures and laboratory work cannot successfully substitute for actual observation and study of geology in the field. Therefore, our department conducts numerous field trips to areas of geological interest as parts of courses. Within an hours drive from the University students can observe late Precambrian metamorphic and intusive rocks; Paleozoic undeformed and folded sedimentary rocks; Cretaceous intrusives and glacial marine and fresh water unconsolidated Pleistocene and Recent deposits. In addition, two field schools (Geol. 216, Geol. 316) are conducted by the staff for two weeks in May following the Spring exams.

BSc. Honours in Geology (69 crs.)

Year I

210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
216^3 - Field Methods
231^3 - Physics of the Earth

Year II

311^6 - Introductory Petrology
313^3 - Optical Crystallography
314^3 - Stratigraphy
316^3 - Field Geology
318^3 - Structural Geology II
331^3 - Historical Geology
332^3 - Economic Geology

Year III

411^6 - Igneous and Metamorphic Petrology
413^3 - Sedimentary Petrology
414^6 - Undergraduate Research
415^3 - Plate Tectonics & Crustal Evolution
417^3 - Mineral Deposits

in addition: Comp. 212^3 or equivalent

3 credits chosen from Biol. 322^3, Geog. 362^3

BSc. Specialization in Geology (63 crs.)

Year I

210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
216^3 - Field Methods
231^3 - Physics of the Earth

Year II

311^6 - Introductory Petrology
313^3 - Optical Crystallography
314^3 - Stratigraphy
316^3 - Field Geology
318^3 - Structural Geology II
331^3 - Historical Geology
332^3 - Economic Geology

Year III

411^6 - Igneous and Metamorphic Petrology
413^3 - Sedimentary Petrology
415^3 - Plate Tectonics & Crustal Evolution
417^3 - Mineral Deposits

In addition: Comp. 212^3 or equivalent

3 credits chosen from Biol. 322^3, Geog. 362^3

BSc. Specialization in Geology-Physics (83 crs.)

Year I

Geol. 210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
Phys. 232^3 - Theoretical Physics I
243^3 - Classical Mechanics I
253^3 - Electricity & Magnetism I
254^3 - Electricity & Magnetism II
Math. 262^3 - Advanced Calculus I
263^3 - Advanced Calculus II

Years II & III

Geol. 216^3 - Field Methods
231^3 - Physics of the Earth
311^6 - Introductory Petrology
331^3 - Historical Geology
332^3 - Economic Geology
415^3 - Plate Tectonics & Crustal Evolution
422^3 - Exploration Geophysics
Phys. 291^1 - Experimental Mechanics I
293^1 - Experimental Electricity and Magnetism I
295^2 - Experimental Electronics I
364^3 - Atomic Physics
334^3 - Thermodynamics

in addition:

9 credits chosen from Geol. 232^3 and Geol. 300- and 400-level courses.
10 credits chosen from Phys. 244^3, 252^3, 292^1, 294^1, 297^1, 335^3, 336^3, 393^1, 394^1, 465^3, 495^1

Specialization in Geology-Chemistry (82-83 crs)

Year I

Geol. 210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
216^3 - Field Methods
Chem. 217^3 - Analytical Chemistry I
218^3 - Analytical Chemistry II
241^3 - Introduction to Inorganic Chemistry
242^3 - Chemistry of the Main Group Elements
Comp. 212^3 - Introduction to Computers and Computing

Years II & III

Geol. 231^3 - Physics of the Earth
311^6 - Introductory Petrology
331^3 - Historical Geology
332^3 - Economic Geology
415^3 - Plate Tectonics and Crustal Evolution
Chem. 231^2 - Physical Chemistry I: Introduction
233^2 - Physical Chemistry II: Spectroscopy & Quantum Theory
290^3 - Laboratory Automation and Data Handling
312^3 - Intermediate Analytical Chemistry
332^2 - Physical Chemistry IV: Thermodynamics
338^2 - Physical Chemistry Laboratory I
341^3 - Inorganic Chemistry III: The Transition Metals

in addition:

12 credits chosen from Geol. 232^3, 312^3, 313^3, 390^3, 411^6, 417^3, 421^3, 423^3

5-6 credits chosen from Chem. 221^3, 222^3, 339^2, 398^3 or 498^3

BSc. Specialization in Resource Analysis and Land Use (78 crs)

Year I

Geol. 210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
216^3 - Field Methods
231^3 - Physics of the Earth
Geog. 211^6 - Introduction to Human Geography
267^3 - Introductory Cartography

Year II & III

Geol. 311^6 - Introductory Petrology
331^3 - Historical Geology
332^3 - Economic Geology
415^3 - Plate Tectonics and Crustal Evolution
Geog. 317^3 - Population Geography
357^6 - Resource Analysis
372^6 - Analysis of the Environment
475^3 - Hydrology I

in addition:

12 credits chosen from Geol. 232^3 and Geology 300- and 400-level courses

6 credits chosen from either Poli. 361^3, 363^3 OR *Econ. 391^3, 396^3

*Requires prerequisites of Econ. 201^3, Econ. 203^3

BSc. Specialization in Geology-Ecology (78 crs)

Year I

Geol. 210^3 - Physical Geology
211^3 - Mineralogy
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
Biol. 230^3 - Animal Biology
240^3 - Plant Biology
250^3 - Fundamentals of Ecology
322^3 - Biostatistics I

Years II & III

Geol. 216^3 - Field Methods
224^3 - Introduction to Remote Sensing and Terrain in Analysis
231^3 - Physics of the Earth
311^6 - Introductory Petrology
331^3 - Historical Geology
332^3 - Economic Geology
415^3 - Plate Tectonics and Crustal Evolution
Biol. 270^3 - Introductory Microbiology
344^3 - Biology of Algae
351^3 - Field and Laboratory Ecology
353^3 - Intermediate Ecology
355^3 - Fundamentals of Limnology
480^3 - Ecotoxicology

in addition:

9 credits chosen from Geol. 232^3 and Geol. 300- and 400-level courses
3 credits chosen from Biol. 321^3 and 454^3

BSc. Major in Geology (39 crs.)

Year I

Geol. 210^3 - Physical Geology
211^3 - Mineralogy I
212^3 - Invertebrate Paleontology
213^3 - Structural Geology I
216^3 - Field Methods
231^3 - Physics of the Earth

Years II & III

Geol. 311^6 - Introductory Geology
331^3 - Historical Geology
332^3 - Economic Geology
415^3 - Plate Tectonics and Crustal Evolution

in addition:

6 credits chosen from Geol. 232[3] and Geol. 300- and 400-level courses.

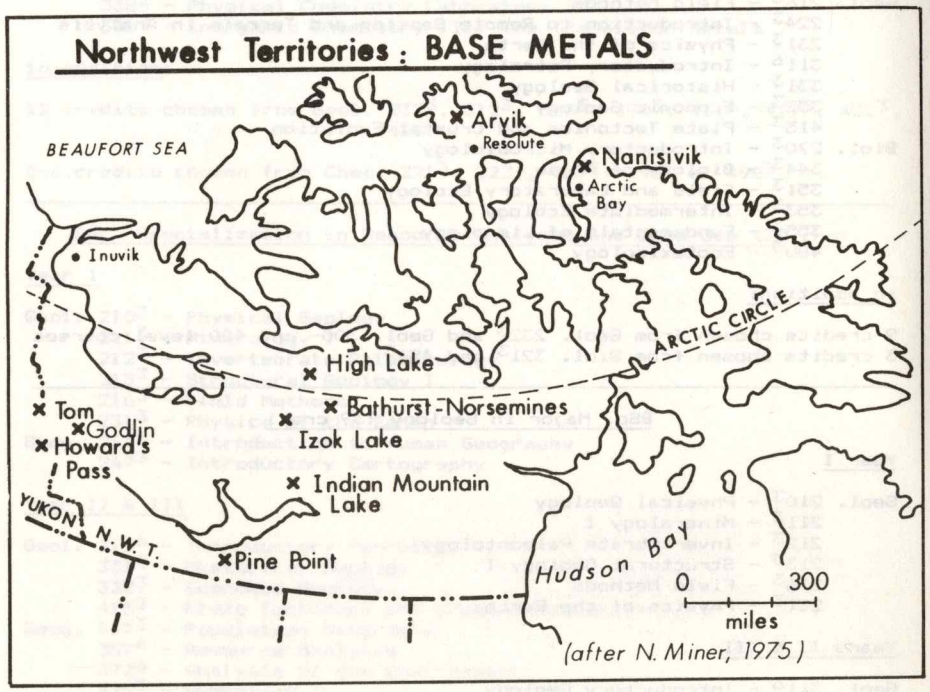
Minor in Geology (24 crs.)

Geol. 210[3] - Physical Geology
211[3] - Mineralogy I
212[3] - Invertebrate Paleontology
213[3] - Structural Geology I

in addition: 12 geology elective credits

NOTE:

1. The superscript denotes the credit value
2. Geology 202[3], 203[3], 205[3], 206[3], 207[3], 208[3], 210[3] and 211[3] may be taken by students with no previous background in geology.
3. Students with CEGEP geology 901 are exempted from Geol. 210



GEOLOGY 203

INTRODUCTION TO ENVIRONMENTAL GEOLOGY (3 credits)

Professor: T.B.A.

Description: A course designed for the student with no previous background in geology who is interested in the geological problems related to the environment. A study will be made of the planet as a closed system with limited resources. Areas of concentration will be: the physical processes and the environment including landscape evolution; the geologic cycles including weathering, erosion, transportation and deposition; geological hazards related to rivers, landslides, earthquakes, volcanoes, coasts; the interaction between man and the environment including the long range effects of ecosphere pollution; the understanding of control for and prevention of natural hazards; proper land use and landscape evaluation; the role of geology related environmental laws. Lectures only.

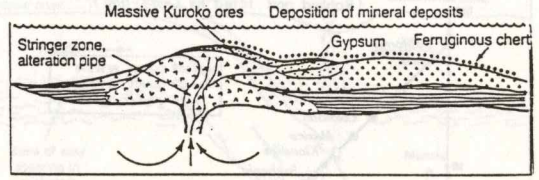
Text: Environmental Geology, E.A. Keller, C. Merrill

Environmental Science, P.U. Purdom, S.H. Anderson, C. Merrill

Assignments & Grading: Term Tests.....45%
Final exam.....55%

Prerequisite: No previous background in geology required

Note: Geology students in Honours, Specialization or Major programmes may not take this course for geology credits.



Steam explosions leading to the development of Kuroko ores

GEOLOGY 205

NON-RENEWABLE RESOURCES (3 credits)

Professor: T.B.A.

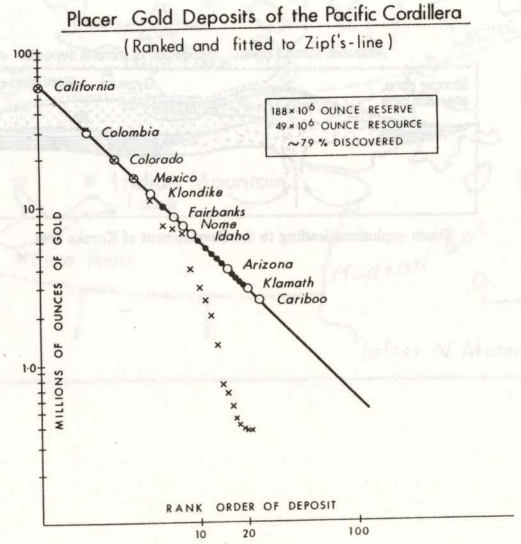
Description: This course is designed for the student with no previous background in Geology. The course will deal with the past, present and future availability of natural resources considering social needs, consumption patterns and future supply and demands of land, base metals, energy, industrial minerals, fossil fuels, water, and other resources. Concepts related to exploration, development and rational exploitation of resources will be examined keeping in mind the nature, classification and mode of occurrence of mineral deposits and their world distribution patterns. Some lectures will also be dedicated to concepts related to the production and exploitation of hydro and geothermal power and to nuclear, wind and solary energy. Lectures only.

Note: Students in degree programmes in geology may not take this course for credits.

Text:
- Earth Resources, B. Skinner, Prentical Hall
- Earth Bound, C.F. Park, Freeman
- Our Finite Mineral Resources, S.E. Kesler, McGraw-Hill
- Mineral Resources, J.A. Wolfe, Chapman and Hall

Assignments & Grading:
- Term test 50%
- Final exam 50%

Prerequisite: No previous background in geology required.



GEOLOGY 206

EARTHQUAKES, DRIFTING CONTINENTS AND VOLCANOES (3 credits)

Professor: T.B.A.

Description: Since the very beginning man has had an inborn and ever increasing curiosity about the meaning and origin of natural phenomena, and catastrophic ones in particular. This urge to explain their origin and therefore to predict and possibly to react to them has resulted in a vast accumulation of facts and knowledge about volcanoes, earthquakes and continental motions. In the late sixties and early seventies, earth scientists, in a world-wide effort of cooperation, have concluded almost spontaneously that most global events are interrelated, and that they are due to the tendency of an ever-changing earth to establish a state of mobile equilibrium. Gone are the days that stressed permanency of continents and oceans. The course will examine the distribution patterns of large-scale earth phenomena and explore their cause and effect relationships.

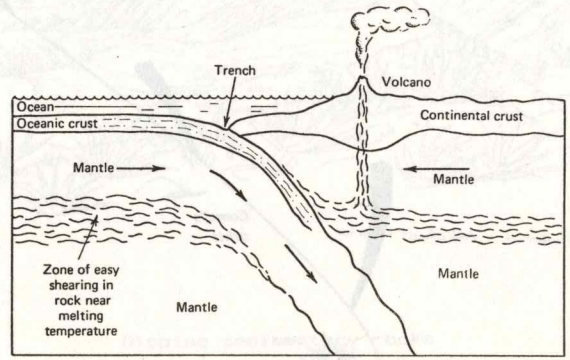
Texts: Inside the Earth, B. Bolt, Freeman; Volcanoes and Earthquakes, G. Oakeshott, McGraw-Hill; Continents Adrift and Continents Aground, Freeman.

Assignments & Grading:

1st test	10%
2nd test	10%
Review questions and/or term paper	20%
Final examination	60%

Prerequisite: No previous geological background required.

Note: Geology students in degree programmes may not take this course for credit



Schematic view showing origin of volcanism along margins of subduction zone

GEOLOGY 208

THE EARTH, MOON AND THE PLANETS (3 credits)

Professor: T.B.A.

Description: "We have walked on the moon and seen beneath the clouds of Venus. And we are all parts of this venture. For thousands of years, people have gazed up at our satellite and seen those familiar man-in-the moon features that perpetually face our planet. Yet we were alive when humanity first saw the hidden side of the moon.....We live in a time of adventure and exploration on the grandest scale". William J. Kaufmann III.

The course emphasizes the cosmic perpsective of the Earth and focuses attention on how the results of the last two decades of planetary exploration have brought about an intellectual revolution concerning the planets, especially their surface features, processes and histories. Lectures only.

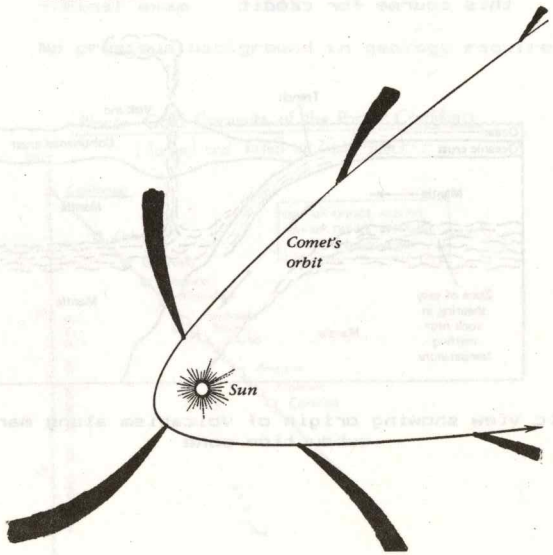
Texts:
- Planets, Bruce Murray, Freeman
- Planets and Moons, William J. Kaufmann III, Freeman
- Earth-like Planets, B. Murray, M. Malin and R. Greenly, Freeman

Assignments & Grading:

Mid Term	50%
Final examination	50%

Prerequisite: No previous background in earth and planetary sciences required.

Note: Geology students in degree programmes may not take this course for credits.



A Comet's Orbit and Tail

GEOLOGY 210

PHYSICAL GEOLOGY (3 credits)

Professor: T.B.A.

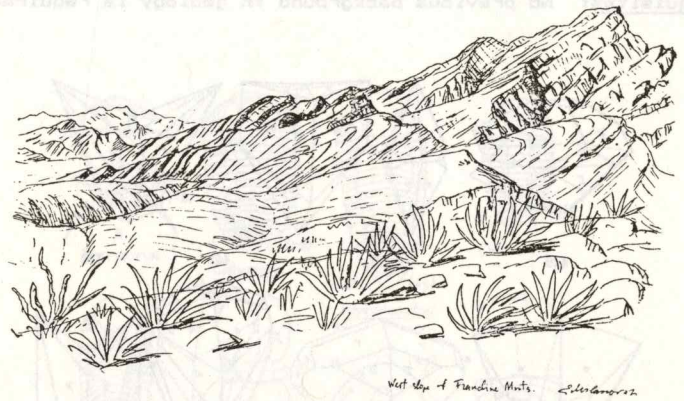
Description: An elementary study of minerals and rocks, and of the internal and external processes which shape the earth's surface. Laboratory work deals with identification of minerals and rocks as well as the interpretation of topographic and geological maps. Field trips to Mt. Royal, Eastern Townships and Laurentians. Lectures and laboratory.

Texts: Physical Geology, 2nd ed., Plumber & McGeary, W.C. Brown

Assignments & Grading:

Laboratory tests...	30%
Mid-term.....	30%
Final Exam.....	40%

Prerequisites: No previous background in geology is required.



Dipping sedimentary rocks

from Rio Grande Rift: Tectonics and Magmatism, edited by R.E. Rieker

GEOLOGY 211

MINERALOGY I (3 credits)

Professor: J.T. Jenkins

Description: Physical and chemical properties of minerals. Crystallography, crystal notation, stereographic projection. Crystal structures. Identification, description and classification of minerals. One or two field trips near Montreal. Lectures and laboratory.

Texts: Hurlbut, Dana's Manual of Mineralogy, 19th ed. John Wiley & Sons

Recommended References:

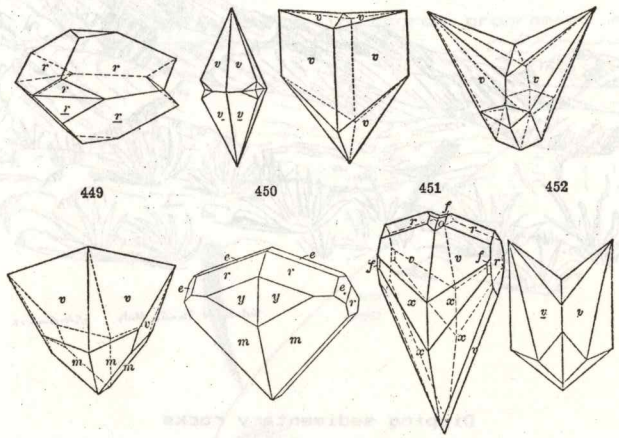
a) Deer, Howie and Zussman. Introduction to Rock Forming Minerals. Longmans (paper-back, 1956).

b) Bloss, F.D. Crystallography and Crystal Chemistry. Holt, Rinehart & Wintson, 1971.

c) Fleischer, M. Glossary of Mineral Species. Mineralogical Record Inc., 1960.

Assignments & Grading:
Lab. Report.....25%
Periodic lab tests & final lab test.....25%
Final examination.....50%

Prerequisites: No previous background in geology is required



Twinning in calcite

from Textbook of Mineralogy by Edward S. Dana

GEOLOGY 212

INVERTEBRATE PALEONTOLOGY (3 credits)

Professor: K.K. Mukherji

Description: A systematic survey of major invertebrate fossil groups with emphasis on morphology, classification and geologic occurrence. Study of principles of evolutionary concepts and zonation. Some selected discussion on paleoecology. Lectures and laboratory.

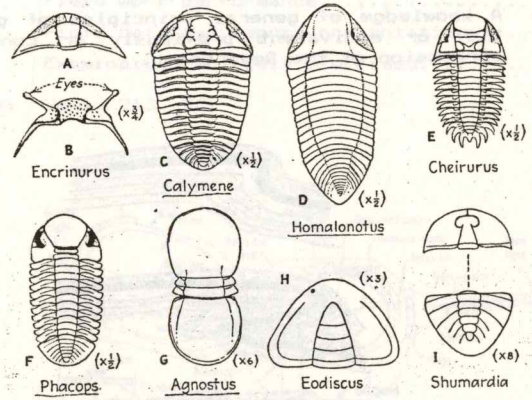
Texts: Fossil Invertebrates, Boardman, R.S., Cheetham, A.H. and Rowell, A.J., BSP.

Assignments & Grading: Students must attend at least 80% of lecture and lab. sessions. Students must secure a definite passing grade in lab. and theory sections separately.

Laboratory assignments.....40%
Final examination.....60%

Examination materials include lecture topics, handouts and special reading assignments. Students may also be required to attend field trips and write reports.

Prerequisites: Geol. 210 or equivalent



Trilobites

from Invertebrate Paleontology by W.H. Twenhofel and R.R. Shrock

GEOLOGY 213

STRUCTURAL GEOLOGY I (3 credits)

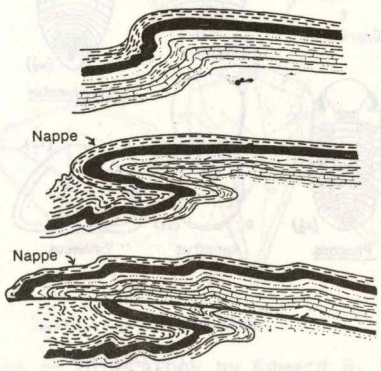
Professor: H.S. de Romer

Description: Structural Geology is the study of features, such as bedding, lava pillows etc. that is, of those structures acquired at the time of rock formation. More importantly, Structural Geology deals with secondary structures, such as folds and fractures acquired during and as a result of deformation. The course will analyse the structural inventory of rocks, and stress the processes of rock formation and their subsequent alteration and deformation. Since the facts of structural geology are based largely on observation, the students will learn to observe and identify basic structures in the field. Gradually, they will develop a three-dimensional picture necessary for the interpretation of the geological and structural evolution of an area. In the labs, the students will use descriptive geometry and stereographic methods to plot and interpret structural data.

Texts: Structural Geology, J.G. Dennis

Assignments & Grading:
Laboratory (including tests)...40%
Theory test.....10%
Field trips.....15%
Final exam.....35%

Prerequisites: A knowledge of general principles of geology (Geol. 210) or equivalent previously or concurrently, or permission of the Department.



Nappe development

GEOLOGY 216

FIELD METHODS (3 credits)

Professor: T.B.A.

Description: One lecture per week in the winter term will be followed in the Spring by a two-week field school, immediately after the final examinations in May.

The lectures will deal with elements of surveying and preparation of base maps, description and recording of geological field data, construction of geological maps, collection and presentation of geophysical and geochemical field data.

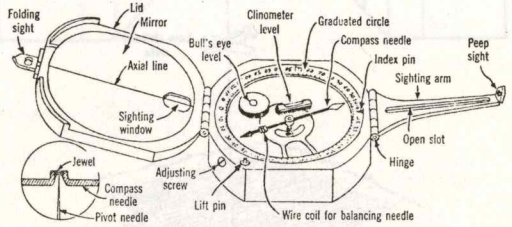
During the field school, students working in groups will carry out field exercises in surveying, geological mapping, geophysical and geochemical surveys of selected sites. Transportation to work sites will be provided. Students must provide their own notebooks, hand lenses and safety glasses.

The period of the field school is a total work immersion period and students should be prepared not only for early starts but also to work late into the evenings in order to process and plot their field data on a daily basis. Report for each activity is to be submitted.

Text: T.B.A.

Assignments & Grading:
Written examinations based on lectures and reading assignments.....15%
Field work performance.....30%
Field data and report presentation.....30%
Examination on field exercises.....25%

Prerequisites: Geol. 213, 231



Brunton Compass

from Manual of Field Geology by Robert R. Compton

GEOLOGY 224

INTRODUCTION TO REMOTE SENSING AND TERRAIN ANALYSIS (3 credits)

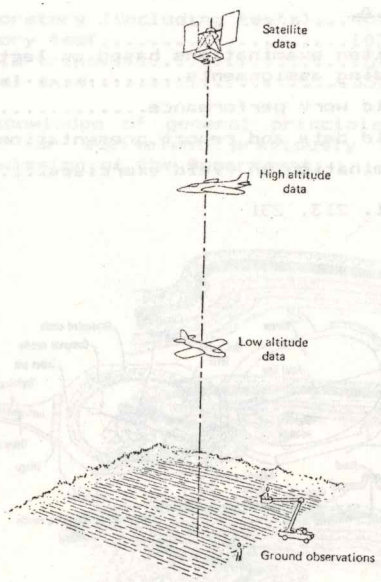
Professor: D.J. McDougall

Description: Lectures introduce the student to the development and application of remote sensing techniques including aerial photography, airborn magnetometer data, aerial thermography, side looking aerial radar and multi-spectral scanning imagery from satellites. Emphasis is placed on geological and geographical application of terrain analysis. In the laboratory several kinds of remote sensing data will be coupled with bed rock and Quaternary maps in the analysis of selected areas.

Text: T.B.A.

Assignments & Grading: Mid term examination.....30%
Final examination.....45%
Laboratory and project...25%

Prerequisites: Geology 210, or Geography 271, or permission of the Department. Students will find it helpful if they have previously taken Geol. 213 and Geol. 311 previously or concurrently.



Multistage Remote Sensing Concept

from Remote Sensing and Image Interpretation by T.M. Lillisand and R.W. Kieffer

GEOLOGY 231

PHYSICS OF THE EARTH (3 credits)

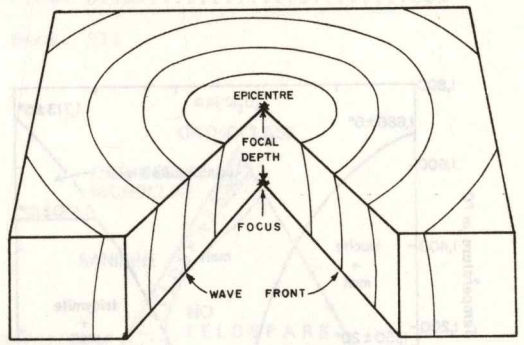
Professor: S. Kumarapeli

Description: This course is directed toward the general understanding of physical phenomena of the solid earth. Subjects for consideration include the following: earth's origin, age, radioactivity, magnetism, gravity field, seismology, heat flow, structure and physical state of the earth's interior, theory of sea-floor spreading, theories of mountain formation. Lectures and laboratory.

Text: Geophysical Methods in Geology. P.V. Sharma, Elsevier

Assignments & Grading: Term paper.....15%
Written examinations.....85%

Prerequisites: CEGEP Math 103, 203; Phys. 301, Geol. 210 or equivalent



Concepts of earthquake epicentre, focal depth and focus

GEOLOGY 232

INTRODUCTION TO GEOCHEMISTRY (3 credits)

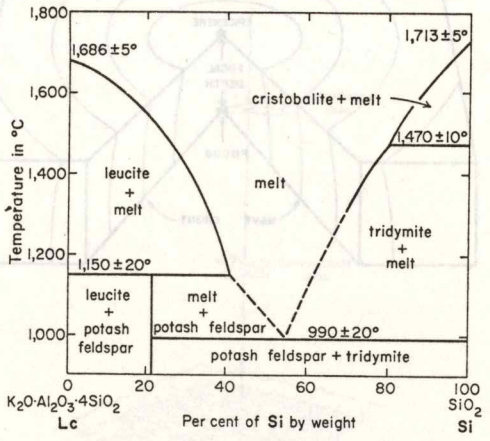
Professor: T.B.A.

Description: The course will focus on the application of concepts of elementary chemistry to geological problems. Subjects for consideration include: application of thermodynamics to geological problems, phase equilibria relationships in petrogenesis, partitioning of elements, crystal chemistry, distribution of elements, chemistry of natural waters including properties of water at high temperature and pressures. Lectures and lab.
NOTE: Students who have credit for Geol. 222 may not take this course for credits.

Text: Introduction to Geochemistry, A.H. Brownlow, Prentice-Hall, Englewood Cliffs.

Assignments & Grading: T.B.A.

Prerequisites: CEGEP Chemistry 201, Physics 301, Mathematics 103, 203; Geol. 210.



One atmosphere isobaric temperature - composition phase relations for the binary system $K_2O.Al_2O_3.4SiO_2$-SiO_2 (Schairer and Bowen, 1947)

GEOLOGY 311

INTRODUCTORY PETROLOGY (6 credits)

Professor: T.B.A.

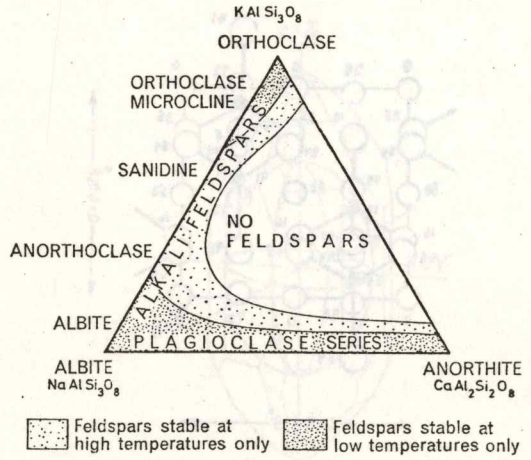
Description: The identification and description of hand specimens of igneous, sedimentary and metamorphic rocks. Study of rock associations, classification and origin of major rock groups. Lectures and laboratory.

Texts: None. This course draws on many sources of its materials, and there are many recommended references, some of which serve as texts in other courses.

a) Winkler, H.G.F. Petrogenesis of the Metamorphic Rocks, 5th ed., Springer Verlag, 1979.
b) Spry, A. Metamorphic Textures, Pergamon 1969
c) Travis Russell. Classifications of Rocks, Colorado School of Mines quaterly, vol. 50, 1955.
d) Ehlers, E.G. and H. Blatt. Petrology, W.H. Freeman & Co., 1982.
e) Greensmith, J.T. Petrology of the Sedimentary Rocks, 6th ed. George Allen and Unwin, 1978.

Assignments & Grading:
Weekly reports in labs.....25%
Three sectional lab exams.....25%
Final exam.....50%

Prerequisites: Geol. 211



Composition of feldspars

from Crystals, Minerals and Rocks by Cox, Price and Harte

GEOLOGY 312

MINERALOGY II (3 credits)

Professor: T.B.A.

Description: Point and translational symmetry, point groups, space groups, interpretation of space group tables, elements of crystal chemistry, chemistry and phase relations of important rock forming minerals. Stereographic projections of crystal data; the Universal Stage and powder diffractometry in identifying minerals are subjects stressed in laboratories. Lectures and laboratory.

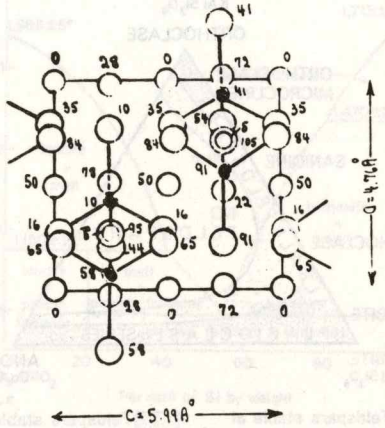
Texts: Bloss, F.D. Crystallography and Crystal Chemistry, Holt, Rinehart and Winston,1971.

Recommended References:

a) Hutchison, C.S. Laboratory Handbook of Petrographic Technique, John Wiley & Sons, 1974.
b) Deer, Howie and Zussman. Introduction to the Rock Forming Minerals (paper), Longmans, 1966
c) Phillips, W.R. and D.T. Griffen. Optical Mineralogy; the non-opaque minerals. Freeman & Co., 1981.

Assignments & Grading: Laboratory assignment...35-45%
Final exam.....65-55%

Prerequisites: Geol. 211 and very strongly recommended 313



Crystal structure of the olivine, fosterite, projected on the (010) plane. Origin at upper right corner.

GEOLOGY 313

OPTICAL CRYSTALLOGRAPHY (3 credits)

Professor: J.T. Jenkins

Description: Behaviour of light in crystals. The optical indicatrix. The polarizing microscope and optical properties of minerals. Identification of non-opaque minerals in oil immersion and thin sections. If time permits use of the Universal Stage will be introduced. Lectures and laboratory.

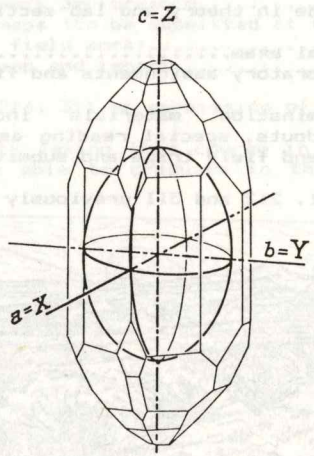
Texts:

a) either: F.D. Bloss. An Introduction to the Methods of Optical Crystallography. Holt, Rinehart, Winston, 2nd ed. 1974.
or
E.E. Wahlstrom. Optical Crystallography, 5th ed., John Wiley & Sons, 1976

b) Phillips, W.R. and D.T. Griffen. Optical Mineralogy; The Non-opaque Minerals. Freeman & Co., 1981.

Assignments & Grading: Weekly laboratory assignments.....25%
Laboratory exam.....25%
Final exam.....50%

Prerequisites: Geol. 211



Optical orientation of orthorhombic crystal

GEOLOGY 314

STRATIGRAPHY (3 credits)

Professor: K.K. Mukherji

Description: Introduction to historical developments of stratigraphic concepts. Role of natural dynamic processes in the evolution of stratigraphic record. Discussion on stratigraphic classification and nomenclature. Major classification of tectonic elements in sedimentary basins and broad patterns in the distribution of sedimentary rocks in relation to tectonic framework. Detailed analysis of stratigraphic principles such as correlation (lithostratigraphic, biostratigraphic, chronostratigraphic) facies (lithofacies, biofacies), unconformities and cyclothem. Critical evaluation of stratigraphic sequences using modern and ancient examples for the recognition of aeolian, alluvial fan, fluvial, lacustrine, tidal flats, barrier coastlines, carbonate shore line, shallow marine and submarine environments. Lectures and laboratory.

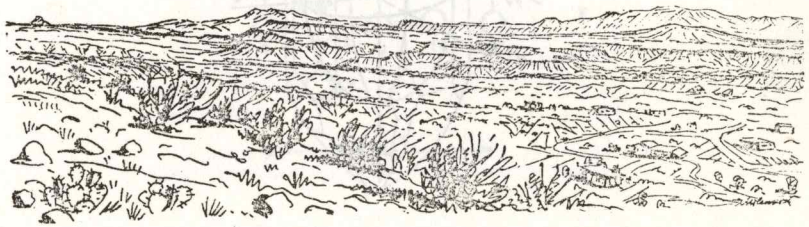
Texts:
- Principles of Sedimentology and Stratigraphy, Boggs, Sam., Merrill.
- Reading, H.D. Sedimentary Enviroments and Facies. Elsevier
- Dunbar, C.O. and Rodgers, J. Principles of Stratigraphy. John Wiley & Sons

Assignments & Grading: Students must attend at least 80% of lecture and lab sessions. Students must obtain a definite passing grade in theory and lab sections separately.

Final exam.....50%
Laboratory assignments and field reports..50%

Examination materials include lecture topics, handouts, special reading assignments. Students must attend field trips and submit reports.

Prerequisites: Geol. 212 and 311 previously or concurrently.



Horizontally bedded formations

From Rio Grande Rift: Tectonics and Magmatism edited by R.E. Riecker

GEOLOGY 316

FIELD GEOLOGY (3 credits)

Professor: T.B.A.

Description: Two-week field school immediately after the final examinations in May. Main aim of the course is to provide exercises in the collection, recording and compilation of field data pertaining to lithology, field relations, areal distribution, structure, stratigraphy and metamorphism of mappable rock units of selected areas with complex geology and to synthesize the data into geological maps and make written reports on the geology.

The two week-time will be devoted to mapping an area in the Appalachian foldbelt with polyphase deformation or an area in the Grenville Structural Province underlain by the Grenville Super Group.

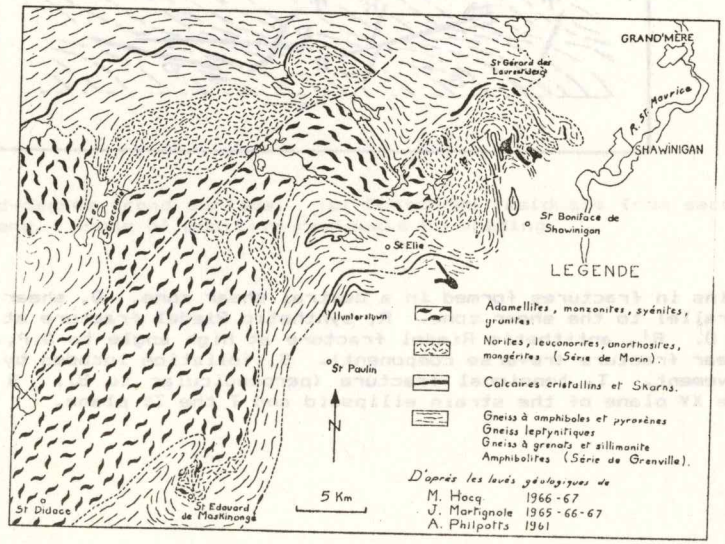
Students will carry out the mapping in groups of two but the final maps and reports are to be submitted on an individual basis. The Department will provide transportation; students must pay for their board and lodging. The Department also will provide compasses. Students must provide their own geological hammers, notebooks, hand lenses and safety glasses.

Texts: T.B.A.

Assignments & Grading:
Field work performance.....30%
Draft maps (to be submitted at the end of the field work).....20%
Final map and report.....50%

Prerequisites: Geol. 216, 311 or permission of the Department

Note: Students taking this course in their final year may not be able to graduate in the Spring of the same year.



GEOLOGY 318

STRUCTURAL GEOLOGY II (3 credits)

Professor: T.B.A.

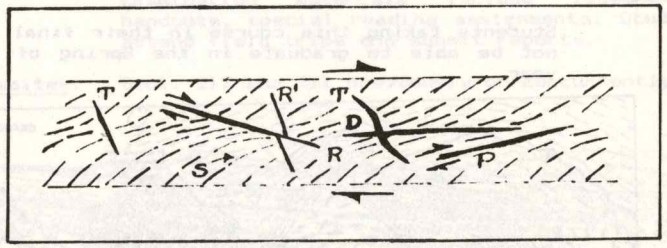
Description: Structural Geology I (213) covers in a more descriptive way the subject matter of structural geology. This course (Geol. 318) looks in detail into the origin and tectonic significance of folds, fractures foliations and lineations. Current concepts on mechanisms of deformation are also studied. Since most rocks in mountain belts the world over show evidence of multiple deformation, the techniques for unraveling superimposed tectonics are looked into.

Laboratory exercises bear on the use of geometric, stereographic techniques and other methods of representation to assist in the solution of field problems.

Text: An Outline of Structural Geology, B. Hobbs, W. Means and P. Williams, John Wiley & Sons Inc.

Assignments & Grading:
Mid-term exam..... .....30%
Final exam.....40%
Laboratory exercixes.....20%
Laboratory test.....10%

Prerequisites: Structural Geology I (Geol. 213) or equivalent.



Veins in fractures formed in a dextral shear zone. D, shear fractures parallel to the shear zone. R, synthetic Riedel fracture at low angle to D. R', antithetic Riedel fracture at high angle to D.P, synthetic shear fracture (reverse component). S, foliation incuded by the shear movement. T, tensional fracture (perpendicular to S). S parallels the XY plane of the strain ellipsoid and T the ZY plane.

GEOLOGY 325

GEOSTATISTICS AND COMPUTER APPLICATIONS IN GEOLOGY (3 credits)

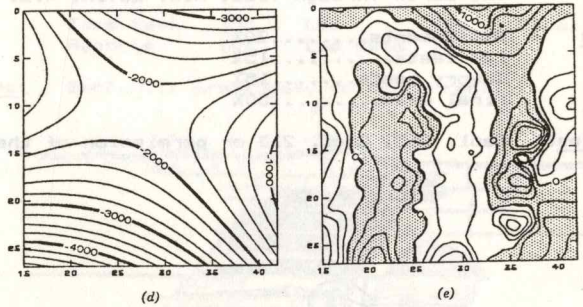
Professor: T.B.A.

Description: An introductory course in the application of statistical methods to geological problems. Topics covered included sampling from geological populations; population distribution: binomial, Poisson, normal and lognormal distribution; sampling distribution and applications; Analysis of variance; simple linear regression; introduction to multivariate data analysis techniques; multiple regression, factor analysis, cluster analysis and discriminant analysis. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisites: Geol. 210 or equivalent



(d) Second-degree trend surface. (e) Contoured residuals from second degree trend. Areas of positive residuals by shading.

GEOLOGY 331

HISTORICAL GEOLOGY (3 credits)

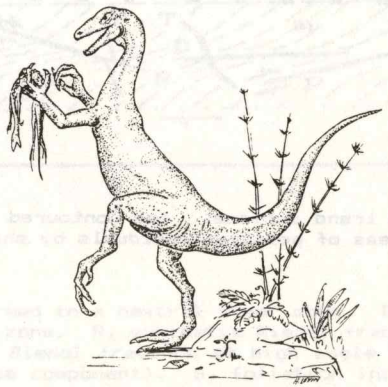
Professor: S. Kumarapeli

Description: The study of the Earth can be divided into two interrelated parts namely: Physical Geology and Historical Geology. While the former deals mainly with descriptive and static aspects of Geology, Historical Geology looks at the Earth from a dynamic and global, evolutionary point of view, stressing Time and Life as its most important elements. It is while studying the historical aspects of geology that one becomes aware that these two dimensions have been added. The course stresses two aspects of Earth History, namely, a) the principles, i.e. that earth materials are the natural products of physical, chemical and biological processes in Time; (It is important to realize here, that the greater part of the record is tied up with sedimentary rocks) and b) the Earth History proper, i.e. the evolution of the earth as a globe throughout the Eras. Since the physical and biological aspects of the earth's evolution cannot effectively be separated, the development of life forms through time is also explored. Lectures and laboratory.

Text: The Earth Through Time, H.L. Levin, W.B. Saunders Co.

Assignments & Grading:
Assignments.....20%
Lab tests.....15%
Theory tests.....15%
Final exam.....50%

Prerequisites: Geol. 212, Geol. 213 or permission of the department



The small Jurassic theropod *Ornitholestes*

GEOLOGY 332

ECONOMIC GEOLOGY (3 credits)

Professor: G.P. Sassano

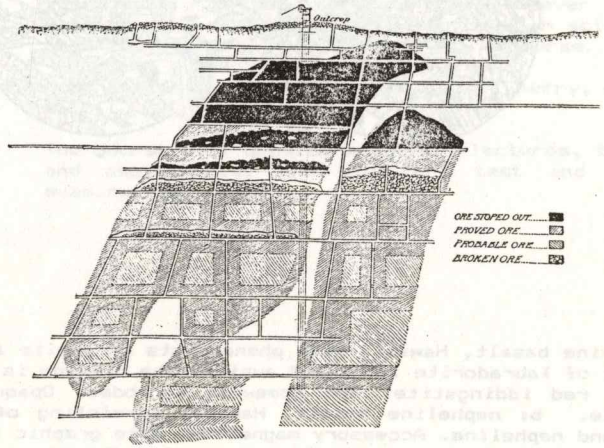
Description: This course is designed for students having some basic notions of geology (see prerequisite). The course deals with the nature, origin, classification and economic evaluation of mineral deposits. Concepts related to the economics of the mining industry including the life cycle of a mining operation, the evaluation of natural resources, the calculation of reserves and economic analysis and profitability of mineral deposits will be studied. The course will also deal with concepts related to the chemicophysical and structural controls responsible for the formation of ore deposits, concepts of zonation and notions of metallogenic provinces and metallotects. Concepts related to reconnaissance, mapping, mineral exploration, geophysics and geochemistry interpretation will also be dealt with. Lectures and laboratory.

Note: Students who have received credit for Geol. 412 may not take this course for credit.

Texts: Exploration and Mining Geology, W.C. Peters, John Wiley & Sons
Ore Deposits, Park and MacDiarmid, Freeman

Assignments & Grading: Term test 25% Lab 25% Final exam 30%
Reports 10% Lab exam 10%

Prerequisites: Geol. 311 previously or concurrently



Longtitudinal section of a mine

from Principles of Mining by H.C. Hoover

GEOLOGY 390

PETROLOGY (3 credits)

Professor: T.B.A.

Description: Microscopic study of thin sections of common igneous, metamorphic and sedimentary rocks. Selected topics in petrogenesis. Lectures and laboratory.

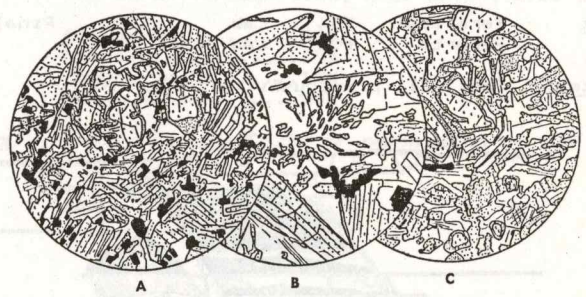
Text: Petrography, H. Williams, F. Turner, C. Gilbert, Freeman

Assignments & Grading: Laboratory exams.....50%
Theory exams.....50%

Students must pass both the laboratory and theory examinations to obtain credits for this course.

Prerequisites: Geol. 311, 313

Note: Students who have received credit for Geol. 411 may not take this course for credits.



A: olivine basalt, Hawaii, with phenocrysts of augite and olivine in a matrix of labradorite laths and augite. The olivine is surrounded by rims of red iddingstite, and somewhat corroded. Opaque mineral is magnetite. b: nepheline basalt, Hawaii, consisting of titaniferous augite and nepheline. Accessory magnetite. Note graphic intergrowth of pyroxene and nepheline. C: olivine basalt, Hawaii, mineralogically similar to A but lacking augite phenocrysts.

GEOLOGY 398C

HYDROGEOLOGY

Professor: T.B.A.

Description: This course provides an introduction to the physical and geochemical aspects of hydrogeology. The lectures cover the fundamental laws and principles used in hydrogeology and applications to groundwater resource evaluation and current environmental problems. The physical aspects discussed in the course include Darcy's law, the groundwater flow equations for steady state and transient conditions, groundwater flow nets, numerical modelling of groundwater flow aquifer testing, groundwater resource evaluation and the influence groundwater on the geotechnical engineering. The geochemical topics covered in the course emphasize groundwater quality, the origin and evolution of major ions in the groundwater zone, groundwater age determination using environmental isotopes, the causes of groundwater contamination, and the processes that can influence contaminant migration including hydrodynamic dispersion, molecular diffusion and adsorption. The course covers practical problems and case histories related to the selection of sites for waste disposal facilities, the assessment of contaminated sites and the remediation of contaminated aquifers.

This course is intended for students in the earth sciences, civil engineering, environmental engineering or physical geography. A knowledge of introductory geology is essential, however students with general college level background in science and physical chemistry may also take the course.

Text: Groundwater by R.A. Freeze and J.A. Cherry, Prentice Hall.

Assignments & Grading: The course will consist of weekly lectures, tutorials and assignments, one mid term test and a final examination.

GEOLOGY 411

IGNEOUS AND METAMORPHIC PETROLOGY (6 credits)

Professor: J.T. Jenkins

Description: Interpretation of phase diagrams. Mineralogy, fabric and petrogenesis of igneous and metamorphic rocks. Magmatic and metamorphic processes. ACF and AKF diagrams for various metamorphic facies. Study of selected problems. Lectures and laboratory.

Texts:

a) Optical Mineralogy, The Non-opaque minerals, Phillips, W.R. and D.T. Griffin. Freeman & Co., 1981.

b) Petrogenesis of the Metamorphic Rocks, Winkler, H.G.F., 5th ed., Spinger-Verlag, 1979.

Recommended References:

a) Ehler's, E.G. The interpretation of Geological Phase Diagrams. Freeman & Co., 1972.

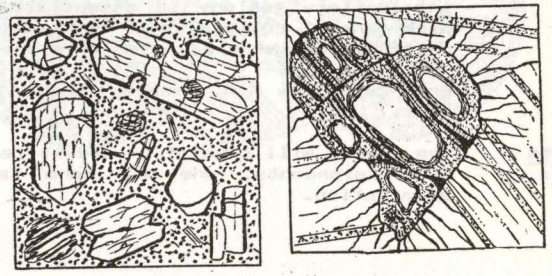
b) Deer, Howie and Zussman. An Introduction to the Rock Forming Minerals (paper). Longman's, 1966.

c) Spry, A. Metamorphic Textures. Pergamon, 1969.

d) Moorhouse, W.W. The Study of Rocks in Thin Sections. Harper, 1959.

Assignments & Grading:
Weekly petrographic reports.....34-45%
Test on Phase Equilibria.....10%
Final exam.....45-55%

Prerequisites: Geol. 311 and 313



Olivine in thin sections of rocks

GEOLOGY 413

SEDIMENTARY PETROLOGY (3 credits)

Professor: K.K. Mukherji

Description: General principles of sediment diagenesis, followed by detailed analysis of the diagenetic evolution of sandstone, shale and carbonate rocks. Emphasis is placed heavily on the microscopic criteria in the recognition of diagenetic fabric. Problems of primary sedimentary structures and their hydro dynamic interpretation are also discussed. Specialized topics on current development in sedimentary lithogenesis are also included.

Texts:

Sedimentology, Leeder, M.R., Allen and Unwin.

Bathurst, R.G.C. Carbonate Sediments and their Diagenesis. Elsevier.

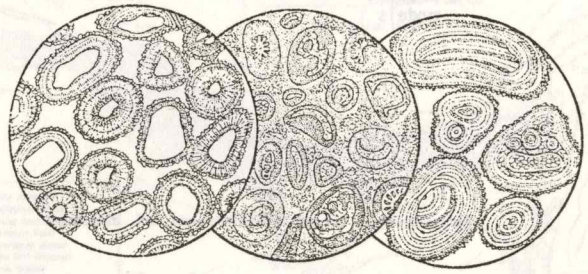
Larsen, G., Chilingar, G.V. Diagenesis in Sediments., Elseiver.

Assignments & Grading: Student must attend at least 80% of lecture and lab. sessions. Students must secure a clear passing grade in theory and lab portions separately.

Laboratory assignments.....50%
Final exam.....50%

Examination materials include lecture topics, handouts, special reading assignments.

Prerequisites: Geol. 311 and 313



Oolitic limestone through the microscope

from Petrography by Francis, Turner and Gilbert

GEOLOGY 414

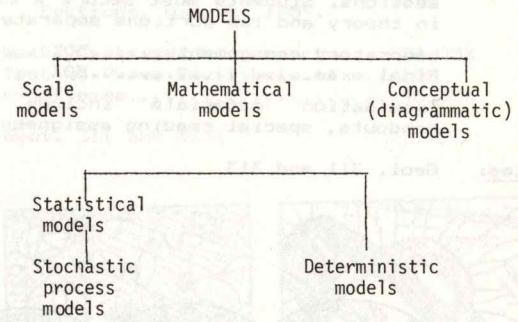
UNDERGRADUATE RESEARCH (6 credits)

Professor: Staff

Description: Honours students in their final year are expected to show competence in isolating and examining a geological problem under the supervision of a faculty. A written application to take the course, including a brief outline of the research project, must be made to the Department before April 15 of the second year. The application will be reviewed by a committee and a decision forwarded by mail. The results of research must be presented in the form of an undergraduate thesis, two copies of which must be submitted by April 25.

Note: Written requests from Specialization students, with appropriate academic records, to take the course will be considered.

Prerequisite: For third-year Honours students.



Schematic classification of models

GEOLOGY 415

PLATE TECTONICS AND CRUSTAL EVOLUTION (3 credits)

Professor: T.B.A.

Description: Techniques of data collection in tectonics. Structure and rheology of the upper mantle. Tectonics of crustal types to include shields, platforms, passive continental margins, Phanerozoic foldbelts, continental rifts, island-arc trench belts and oceanic rises. Sea-floor spreading, plate tectonics, magma associations and plate reconstructions. Crustal origin and growth. Lectures and laboratory.

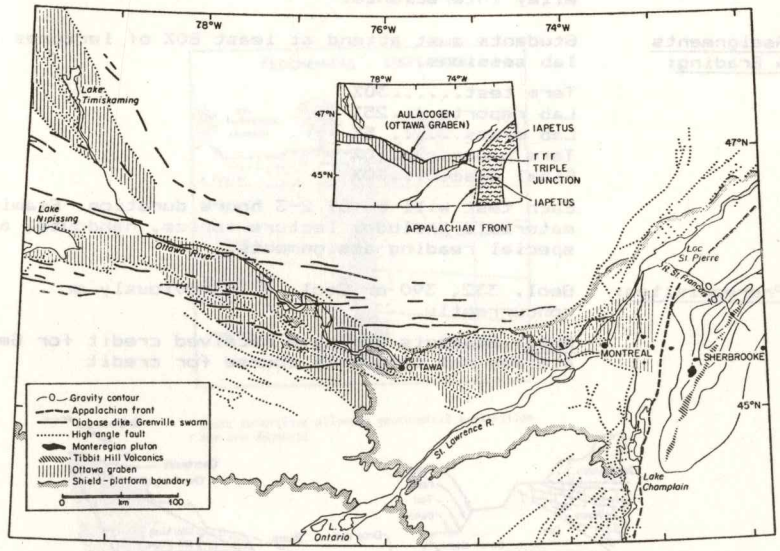
Note: Students who have received credit for Geol. 315 may not take this course for credits.

Texts: Plate Tectonics & Crustal Evolution, K.C. Condie, Pergamon.

The Inaccessible Earth, G.C. Brown and A.E. Musset. Allen & Unwin.

Assignments & Grading: Laboratory assignments...20%
Term paper and seminar...60%
Written exams.....20%

Prerequisites: Geol. 213, 231, 311



Key geological elements of the Ottawa graben in relation to the Tibbit Hill volcanics and Sutton Mountain Gravity High. Inset, interpretive sketch of the Sutton Mountains rrr triple junction.

GEOLOGY 417

MINERAL DEPOSITS (3 credits)

Professor: G.P. Sassano

Description: This course is designed for students with a good background in economic geology. The course will deal with the study of the geological processes related to the formation of ore deposits. It will thus study magmatic segregation, contact metasomatic, hydrothermal, sedimentary, submarine exhalative and volcanogenic processes. The course will also deal with residual, mechanical concentration, and supergene enrichment processes. Concepts of geothermometry, geobarometry and isotope studies will also be dealt with. Examples of geological settings from the most representative mining districts of the world will also be discussed. Laboratory includes examination and study by means of microscopy, fluid inclusions and microhardness tests of rock samples and ore suites from the most representative mining camps of the world. Lectures and laboratory.

Texts: Ore Deposits, Park and McDiarmid, Freeman & Co.

Geochemistry of Hydrothermal Ore Deposits, Barnes, Wiley Interscience.

Ore Petrology, Stanton, McGraw-Hill

Ore Microscopy and Ore Petrology, Graig and Vaughan, Wiley Interscience.

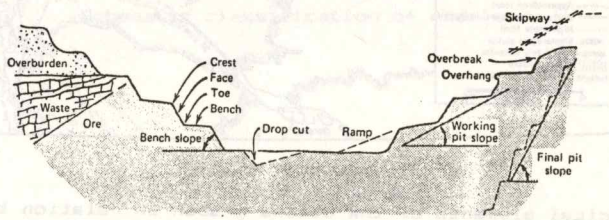
Assignments & Grading: Students must attend at least 80% of lectures and lab sessions.

Term test.....30%
Lab reports....25%
Lab exams..... 5%
Term paper.....10%
Final exam.....30%

Each test will be of 2-3 hours duration. Examination materials include: lecture topics, handouts, and special reading assignments.

Prerequisites: Geol. 332, 390 or Geol. 411 previously or concurrently.

Note: Students who have received credit for Geol. 416 may not take this course for credit



Open-pit (open-cut, open-cast) mining terms

GEOLOGY 421

EXPLORATION GEOCHEMISTRY (3 credits)

Professor: T.B.A.

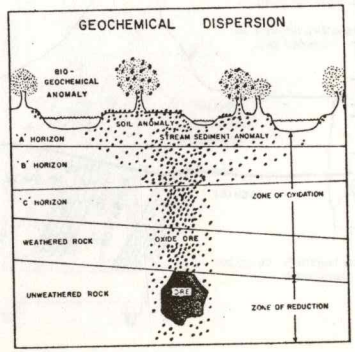
Description: Basic principles: primary and secondary dispersion processes and their significance in geochemical exploration; field and analytical techniques (one field excursion early in the fall term); interpretation of geochemical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Text: Introduction to Exploration Geochemistry, A.A. Levinson, Applied Publishing.

Assignments & Grading: Laboratory work & field trip report...35%
Term paper.....15%
Mid term.....15%
Final exam.....35%

Final examination is based on entire course material. To obain a pass in this course it is essential to obtain a pass mark in the final exam as well as aggregate pass mark.

Prerequisites: Geol. 311 or permission of the Department



Basic conditions allowing geochemical exploration for ore deposits

GEOLOGY 422

EXPLORATION GEOPHYSICS (3 credits)

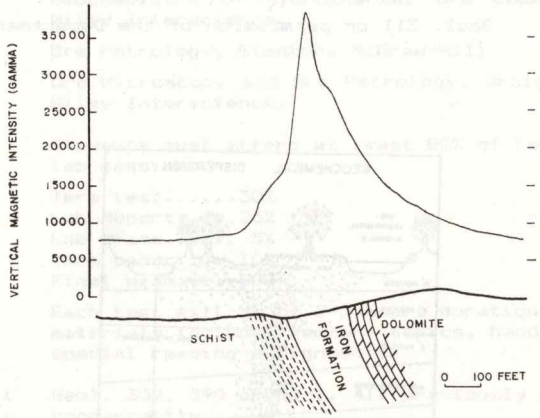
Professor: T.B.A.

Description: A brief study of the principles of magnetic, gravimetric, electric and seismic methods of mineral exploration; interpretation of geophysical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Text: Applied Geophysics, Telford, W.M. Cambridge

Assignments & Grading:
Laboratory assignments....25%
Seminars.....15%
Final exam.....60%

Prerequisite: Geol. 231 or permission of the Department



Magnetic anomaly over a magnetic iron deposit

GEOLOGY 424

ENGINEERING GEOLOGY (3 credits)

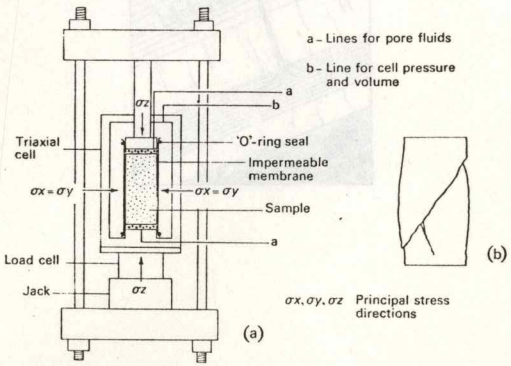
Professor: T.B.A.

Description: Engineering properties of rocks and soils. Landslides, ground water, frost action and permanently frozen ground. Application of geology to engineering problems - concrete petrology, tunnels, slope control, foundations, roads, airports, dams and reservoirs. One term paper to be prepared. The laboratory will include field trips, engineering geology case histories and study of engineering geology problems. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading:
Mid term test.....20%
Final exam.....40%
Lab assignments and term paper.....40%

Prerequisites: Geol. 210, 213; Geol. 224 and 311 are recommended.



Triaxial apparatus (a) and failed specimen of stiff clay (b)

GEOLOGY 425

FOSSIL FUELS (3 credits)

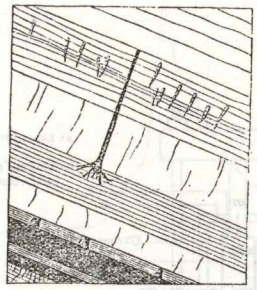
Professor: K.K. Mukherji

Description: Origin and accumulation of petroleum hydrocarbons and coal. Distribution of oil, natural gas and coal deposits as a function of geological environments. Geology of major oil and coal fields of the world. Global energy requirements and production forecasts. Lectures and laboratory.

Text: None. Assigned readings.

Assignments & Grading: Laboratory assignments.....50%
Final exam.....50%

Prerequisites: Geol. 314, 415 previously or concurrently or permission of the Department



Part of Coal Group, South Joggins, N.S.

from "Some salient points in the science of the Earth" by J. William Dawson